knowledge of the factors affecting oxidase activity, but the true value of this contribution would have been better shown by a fuller reference to other work.

KASTLE and BUCKNER[11] report experimental proof that phenolphthalein can be oxidized in the living plant. This they take to mean that free active oxygen is present in the tissues, apparently overlooking the possibility that combined oxygen might have caused the results observed. The reagent used, on oxidation, yields phenolphthalein, which is easily recognized by the pink color it gives with alkalies. When this test was applied to stalks of Indian corn which had been injected with the reagent, the pink color was found localized in the fibrovascular bundles of the stem and leaves. It was not found in the tassel, although lower down, close to the point of injection, there had been some diffusion into the cells adjoining the fibrovascular bundles. Similar results as to place of oxidation were obtained with okra.

The method here used offers a means of attacking the problem of oxidation in plants which should yield other valuable results if further developed and applied to a wider series of plants. It would be worth while to try whether phenolphthalein can be oxidized in the living plant when used in neutral or acid solution, and if so whether the oxidation is localized in particular cells or tissues. Such a test would allow for the effect of reaction (acidity or alkalinity), a factor known to be of great importance, not only in oxidation processes, but also in other processes carried on in living tissues. The effect of reaction might also be studied in acid fruits and in tissues affected by "physiological diseases" or by diseases due to bacterial or fungus parasites. In several cases such tissues have been found to be less acid than healthy ones, but little is known concerning variations in reaction within the tissues themselves.—D. H. ROSE.

Experiments in girdling.—A contribution by HIBINO[12] is of interest both to plant physiologists and horticulturists, since it will aid in furnishing a more definite chemical basis for the interpretation of the behavior of girdled plants. In the past there has been no lack of references to the accumulation of elaborated foods above the girdles; it is certainly worth while to have some definite determinations of these compounds and their relative quantities.

Five types of girdling were tried on *Cornus contraversa* Hemsl. These consisted in (1) removing a complete ring of bark, (2) removing a complete ring of bark and some of the wood, (3) removing half a ring of bark, (4) removing half a ring of bark and wood, and (5) boring completely through the wood. The wounds were left unprotected. The last three methods of treating the material resulted in responses similar to the untreated controls in nearly all cases.

The general external results noted are those commonly recorded in girdling experiments. The main interest of the present paper centers in the presenta-

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[11] KASTLE, J. H., and BUCKNER, G. DAVIS, Evidence of the action of oxidases within the living plant. Jour. Amer. Chem. Soc. **39**:479–482. 1916.

[12] HIBINO, SHIN-ICHI, Effekt der Ringelung auf die Stoffwanderung bei *Cornus controversa* Hemsl. Jour. Coll. Sci. Imp. Univ. Tokyo **39**:1–40. *pls. 1, 2.* 1917.

tion of material which may aid in an explanation of the cause of these conditions. Unfortunately the experiments are limited and the analyses of the nitrogenous compounds are not sufficiently complete to furnish any sort of basis for judging what rôle they may play. The data on the carbohydrates, however, are of considerable interest. In studying the effects of girdling on nutrition in general, at least three of the many points concerned in growth must be considered: (1) a possible modification of the intake of nutrients by the roots; (2) the synthesis of products from these compounds and those resulting from photosynthetic activity; and (3) whether these compounds are stored or utilized. We are given some light on the third point only. It is a fair question to ask whether the ability of the roots to take up salts is not as profoundly modified by the character and quantity of the organic nutrients in the parts above ground and with which such salts may be combined, as it is by the so-called starvation effects brought about by cutting off the supply of organic nutrients from the tops to the roots. Girdling could bring about both of these situations. The question arises as to why the carbohydrates accumulate above the girdles. As commonly stated, this may be due to the fact that these products are held from passing into the roots. There is little evidence which would show that it may not also be due to a deficiency of mineral nutrients, particularly nitrates, to aid in their utilization in forming other compounds or growth. A study of the ratios of carbohydrates to moisture, nitrogenous compounds, and other mineral nutrients in their relation to the entire phenomenon of growth is greatly to be desired. While this situation is not dealt with by HIBINO, his results and those of several previous investigators furnish ample encouragement to warrant investigation.

The increase in anthocyanin accompanying an increase in reducing sugar confirms the findings of previous workers with other plants. The yellowing of the foliage above a girdle is a usual condition. That this should accompany an increase in carbohydrates is interesting. It is unfortunate that no analyses of the nitrogenous compounds in the leaves are available. Lacking such determinations nothing can be said concerning their possible relationship to the carbohydrate situation, nor the moisture situation. The fact that the percentage of moisture in the leaves is lower when carbohydrates form a higher percentage of the weight might be expected when the moisture holding capacity of these compounds is considered.

The single quantitative determination of the reserve materials in the twigs in midwinter is not sufficient for any general conclusions. Again, it is unfortunate that all the nitrogen is computed as protein. It is more than likely that all of it is not, and quite probable that the several forms of nitrogen may exist in different proportions in the several lots examined. A quantitative analysis at the time of active vegetation would have been even more significant regarding the influence of the several substances on growth. Striking as are the differences in the several lots, the results cannot be interpreted with certainty unless compared with figures for similar parts at several periods during the

year. Whether the differences shown by the bark and wood girdled material may be accounted for by a decreased moisture supply in the latter is an open question. It is interesting to note, however, that many plants grown with a deficiency of water do show an increased tannin content.

While it is impossible to draw broad conclusions from the results presented, the work constitutes a genuine contribution toward a more nearly complete knowledge of the causes of the responses following girdling, and adds to the available information on the entire problem of growth. In any future work it would be particularly desirable to follow the nitrogenous compounds and mineral nutrients as well as the carbohydrates, more especially with a view toward the determination of the ratios of these various substances in relation to the observed responses.—E. J. KRAUS.

Imbibition.—MACDOUGAL[13] and MACDOUGAL and SPOEHR[14] are doing work on the effects of acids and bases on imbibition of water by plant tissues and plant gels that promises to be the most significant contribution in this phase of plant physiology that has been made for some decades. Practically all of the work on the effect of acids and bases on the amount of swelling and force of swelling of gels and on the viscosity and osmotic pressure of sols has been done on the amphoteric protein gels. For these it seems well established that the iso-electric point (the reaction at which the particles are without a charge) is the point of minimum swelling, force of swelling, osmotic pressure, and viscosity, and that forcing the ionization of the gel or sol either to the positive by addition of an acid or to the negative by the addition of a base increases the swelling, osmotic pressure, and viscosity very markedly.[15]

MACDOUGAL and SPOEHR find that both base and acid additions (n 0.01) decrease greatly the swelling of agar plates and to a less degree of *Opuntia* tissue. In fact, *Opuntia* tissue acts more like mixtures of gelatine and agar than it does like either gelatine or agar. These results suggest that in contrast to the protein gels and sols, the point of maximum swelling, viscosity, etc., in agar is the iso-electric point and that the positive agar due to acid addition or the negative agar due to base addition shows a lowering of these characters. In this connection it is to be regretted that the H^+ concentration for the iso-electric point of agar has not been determined. It is also desirable to know the behavior of various other carbohydrate gels and sols (mucilages, pectic materials, gums, etc.) to see whether this contrast in behavior is a general difference between the protein and carbohydrate gels. It seems that plant physiologists have generally assumed that the laws of behavior of protein

[13] MACDOUGAL, D. T., Imbibitional swelling of plants and colloidal mixtures. Science **44**:502–505. 1916.

[14] MACDOUGAL, D. T., and SPOEHR, H. A., The behavior of certain gels useful in the interpretation of the action of plants. Science **45**:484–488. 1917.

[15] HOBER, R., Physik. Chemie Zelle Gewebe. 329–338. 1914.